![arc logo] **Partnership for Marine, Estuarine and Freshwater Living Resources**
Aquatic Restoration and Conservation

Dear Colleagues:

We are pleased to send you the summary report for the workshop "Assessing Aquatic Resources: A National Workshop to Determine Information Needs" held September 3-4, 1998, in Washington, DC. Also enclosed is a new "outreach" document that lays out the ideas and goals for cooperation regarding aquatic resources as they were articulated at the workshop.

The objective of the workshop was to obtain guidance at the beginning of a the process of developing a national partnership that will assess and monitor aquatic resources for habitat quality and biological integrity. The workshop was attended by 91 people, representing 40 federal, state, private and professional organizations that work with aquatic resources. Workshop participants developed through consensus a diverse list of resource needs. A common theme throughout the meeting was the need for close cooperation to facilitate sharing of data and information. This shared objective will make it easier and more cost effective to fill information gaps and guide efforts concerned with conservation and management of aquatic resources.

If interest and action are any indicator, we see the workshop as a great success: the results of the workshop have led to the initiation of several important activities that we believe will move the idea of the partnership to a reality. A name has been given to the program, Aquatic Restoration and Conservation Partnership for Marine, Estuarine and Freshwater Living Resources, (the ARC Partnership) and the following goal established:

> "To conserve and restore the ecological and economic integrity of our Nation's marine, estuarine and freshwater living resources by creating a common information base and providing options for decision makers."

The materials enclosed represent the completion of the first two steps identified by the workshop participants: (1) dissemination of the workshop report and (2) development and dissemination of an outreach document that can be used as an educational and marketing tool. The enclosed brochure is the result of a synthesis of the ideas obtained at the workshop. It is a call for those organizations and agencies with interests and responsibilities in marine, estuarine or freshwater resources to come forward and support the partnership. A website has been established at www.arcpartners.org which will provide a common connection for information sharing and dissemination.

As these first steps are completed, it becomes essential that partners step forward to help in the planning and implementation of the essential steps identified in the workshop:

- Form an umbrella steering committee made up of representatives from a broad range of partnering groups and individuals to direct administrative and technical development;
- Identify potential "champions" and partners, and a marketing approach for the ARC Partnership;
- Expand national, state and local participation and establish the fundamental fiscal and personnel resources to achieve the goals of the ARC Partnership and the needs of partner agencies and organizations;
- Develop a plan to address development and comparability of data and information;
- Coordinate efforts in the development of resource classifications and assure comparability with existing classifications;
- Oversee and form theme steering groups, such as a technical committee to begin to develop mapping standards and protocols;
- Identify and develop pilot projects;
- Organize regional meetings, separately or jointly, that will help identify and focus on the needs and concerns of regional participants and introduce them to the ARC Partnership.

It is our hope that this report and brochure will serve as a call to individuals and organizations that recognize the common need for sharing information and other resources to better conserve and manage our diminishing aquatic resources. Please contact us to find out how you can become part of the ARC Partnership. Additional brochures are available for distribution.

Sincerely,

The Workshop Planning Committee

Contact: Rebecca Allee, National Oceanic & Atmospheric Administration, National Marine Fisheries Service, 301-713-2325, Rebecca.Allee@noaa.gov
Pamela Haverland, U.S. Geological Survey, 573-879-1841, pamela_haverland@usgs.gov
www.arcpartners.org

Assessing Aquatic Resources:

A National Workshop to Determine Information Needs

Workshop Report 1998

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I.A.F.W.A

The Nature Conservancy.

≋USGS
science for a changing world

Preface

After the workshop was completed in September 1998, the workshop organizers formed an interim steering committee and began to move forward in implementing the workshop recommendations and making the idea of the Partnership a reality. The partnership now has a name, Aquatic Restoration and Conservation Partnership for Marine, Estuarine and Freshwater Living Resources (ARC Partnership), and a visual identity.

A goal statement was developed to express the focus of the ARC Partnership:

> "To conserve and restore the ecological and economic integrity of our nation's marine, estuarine and freshwater living resources by creating a common information base and providing options for decision makers."

In addition, several initial workshop recommendations are underway.

* A workshop on marine classification systems is being developed by NOAA.

* Potential pilot studies and goals for these studies are under discussion.

* A website has been established.

* Planing for regional workshops has begun.

To continue to create a viable Partnership and move forward with these tasks and other set out in this document, new "partners" are needed to step forth and take part.

Check out the ARC partnership website at **www.arcpartners.org,** or contact Rebecca Allee, (301) 713-2325, rebecca.Allee@noaa.gov or Pamela Haverland, (573) 876-1841, pamela_haverland@usgs.gov to find out more.

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Executive Summary

This document summarizes the ideas and recommendations from the national workshop "Assessing Aquatic Resources: A National Workshop to Determine Information Needs." The 1.5-day workshop wasconvened on September 3-4, 1998, by a multi agency and organizational committee led by the U.S.Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA) and the Ecological Society of America (ESA). The workshop brought together 91 people, representing 40 federal, state, private and professional organizations that work with aquatic resources. The workshop's objective was to obtain early guidance in developing a national program that would assess and monitor aquatic resources for habitat quality and biological integrity.

The development of an aquatic habitat assessment program was prompted by the recognition that freshwater, estuarine and marine species and communities are facing increasing risks due to habitat loss, degradation and overexploitation of aquatic resources. In 1998, USGS and NOAA started developing a national partnership that would bring together the major contributors and users of the products from an aquatic habitat assessment program. These agencies and others recognize that the benefits of an aquatic habitat assessment partnership would unify and make comparable characterizations of freshwater, estuarine and marine biological resources.

The goal of the aquatic habitat assessment partnership is to characterize and map freshwater, estuarine and marine species and their communities and habitats using a geographic information system (GIS) format to better conserve and manage these resources. This workshop was the initial step in developing this partnership.

Workshop Format and Objectives

The workshop opened with presentations that provided background on the current status and need for an aquatic habitat assessment program. The following afternoon and morning consisted of facilitated sessions that focused on three resource related questions: What aquatic resource issues does your organization face? What aquatic resource questions do you need to answer? and How do you currently get the information to answer these questions? The final session convened all the participants to focus on identifying a set of initial steps that should be taken to begin the program.

Working Group Outcomes

For the facilitated breakout sessions, workshop attendees were divided into three groups: streams, marine/estuarine and lakes/wetlands. These groups provided interesting similarities and contrasts in the level of work already underway and in the overall priorities identified. Among the three groups, rivers/streams had the greatest amount of information and practical experience to draw upon in respect to habitat assessment activities. Broad-scale assessment of aquatic biological resources already exists at the federal level including ongoing aquatic gap analysis pilot projects in Missouri and New York. Both the streams and the lake/wetlands groups identified as priority areas to be addressed by The Partnership, data issues such as standards in definitions, methodology, collection and storage, compatibility with other information systems and organization of

existing data. Within the marine/estuarine group there was a consensus that significantly less information was available on marine than on freshwater resources. Supporting a "fact-finding" mission was considered a high priority by this group. All three groups agreed that a principal objective would be to develop a consistent and compatible classification system. This system would require integration among the various habitat types, including a terrestrial component.

Next Steps and Recommendations

The enthusiastic response to the workshop and overall active participation in the plenary and breakout group discussions affirmed the interest and need for a consistent and compatible system that would identify, characterize and make accessible aquatic resource information. Based on what was discussed at the meeting, the following sequence of steps was recommended:

1. Disseminate the workshop report to all participants and other interested parties.

2. Develop and disseminate an outreach document that can be used as an educational and marketing tool.

3. Form an umbrella steering committee, made up of representatives from a broad range of partnering groups and individuals. The purpose of the steering committee would be to direct administrative and technical development including creating a vision and goal statement, a plan to address classification and standardization issues and oversight of theme steering groups.

4. Form theme steering groups for marine and freshwater (with separate stream and lake groups or combined). Among their responsibilities, these groups will identify needs and partners for each group, develop pilot projects and organize regional meetings to address technical and partnership issues at national, regional and state levels.

Conclusions

This workshop was an important first step in the development of an important and timely partnership. Reaching the goals that were identified will take time and effort. To be successful and useful, The Partnership will have to include the full involvement and cooperation of major users and stakeholders as well as the support and commitment of agencies and groups that would benefit from the information developed by an aquatic partnership.

I. Introduction

Habitat is essential to the sustainability of populations. Many of the species listed as threatened or endangered suffer from a loss or degradation of their optimal habitat. Without quality habitat, these populations cannot be sustained. Aquatic environments - freshwater, estuarine and marine - are less understood than their terrestrial counterparts and face different challenges. In aquatic environments, habitat is generally subjected to far more types of degradation and depletion than terrestrial habitats. Such factors as water quality and quantity, channelization and streambank or shoreline erosion can play crucial roles in altering habitat.

As urban, industrial and agricultural expansion accelerates and intensifies to meet the needs of growing populations, threats to aquatic habitats also increase. Currently, 70% of our Nation's rivers are impacted by agricultural non-point source pollution and 28% of surveyed estuaries are impaired due to water quality or habitat degradation (EPA 1998). A significant portion of these environmental impacts finds its way down to the marine environment. Sewage discharge alone is a major source of coastal pollution, contributing 41%, 16%, 41% and 6% of the total pollutant load for nutrients, bacteria, oils and toxic metals, respectively, and may also contain significant amounts of organic matter that exert a biochemical oxygen demand, frequently leading to hypoxia (Kennish 1998).

The development of an aquatic habitat assessment partnership (The Partnership) was prompted by the recognition that freshwater species and communities are among the most threatened in the Nation. A recent analysis of the status of major species groups (Stein & Flack 1997) indicated that freshwater aquatic species were at greatest risk. Of the dozen major taxa identified in the report, the most threatened were freshwater mussels, crayfish, amphibians and freshwater fishes. For

The goal of the aquatic habitat assessment partnership is to characterize and map freshwater, estuarine and marine species and their communities and habitats to better conserve and manage these resources.

example, 71% of North American mussel species have been evaluated as endangered, threatened or of special concern (Williams et al. 1992).

There is less information on the status of marine species but current evidence indicates these resources are increasingly at risk. Anadromous and near-shore marine species are widely recognized as being threatened or seriously depleted. For example, in 1991, 214 native, naturally spawning Pacific salmon, steelhead and sea-run cutthroat trout stocks from the Northwest were classified as facing high or moderate risk of extinction (Nehlsen et al. 1991). Since then, 23 populations have been listed under the Endangered Species Act. Sufficient data are available for only 300 of 844 federally managed marine species, 30% of

which are overfished. The status of the remaining 544 species is unknown (NMPS 1998). It has been estimated that 10% of the world's coral reefs have already been degraded beyond recovery, and 30% more may decline in the next 20 years (Jameson et al. 1995). Studies such as these indicate that marine resources in the United States and worldwide are in significant decline.

With the recent increases in Endangered Species Act listings of aquatic organisms, habitat managers have begun calling for a means to assess and monitor our aquatic resources for habitat quality and biological integrity In response, the September 1998 national workshop was convened to discuss information needs for assessing aquatic habitat. The workshop allowed participants to identify their concerns and issues regarding resource conservation and management. It marked the beginning of the development of a nationally compatible aquatic habitat assessment program.

The concept of The Partnership has its beginnings in the framework that the National Gap Analysis Program established in 1987, which is now active in 46 states (Box A). The purpose of gap analysis is to develop a landscape or coarse-scale analysis of species distributions and the environmental factors that affect them. The goal of the Partnership is to characterize and map freshwater, estuarine and marine species and their communities and habitats to better conserve and manage these resources. The unique contribution of this Partnership is that it will provide information in an accessible format at an appropriate geographic scale.

Developing an Aquatic Habitat Assessment Program

The need for an aquatic habitat assessment program arose from a variety of sources: mandates in the Department of the Interior and the National Oceanic and Atmospheric Administration (NOAA), from other federal agencies, from states and from private interests. This need for a nationally consistent approach for characterizing distribution patterns, landscape-level environmental factors, management and the conservation status of important aquatic species has long been recognized among state natural resource agencies. One such example is the Multi-State Aquatic Resources Information System (MARIS) which is a consolidation of existing freshwater fisheries data in five states in the upper Midwest (Beard et al. 1998).

In 1994, the U.S. Geological Survey (USGS) began a series of investigations to launch two freshwater aquatic gap pilot studies and initiated the establishment of the technical foundation for landscape-level analyses of freshwater resources using nationally compatible methods. In 1995, it initiated a watershed-based study of the Allegheny River within New York State and in 1998 it launched a statewide aquatic habitat assessment program pilot for Missouri. USGS and the state fish and wildlife agencies of Illinois, Wisconsin and Wyoming convened a national workshop on freshwater fisheries database issues in February 1998, which examined the potential for developing standards and technological tools to exchange freshwater fisheries data among states - the primary sources of information on freshwater aquatic resources. As part of this workshop, an initial meeting was held on the technical needs and challenges associated with The Partnership and included the participation of many state, federal and private organizations.

Recently, NOAA funded a pilot project that will utilize years of habitat data to begin identifying mechanisms for a marine habitat classification scheme. In addition, NOAA has hosted workshops for coastal zone managers and local stakeholders to help identify and address issues of water quality and habitat degradation. Efforts have also been ongoing within the National Marine Fisheries Service (NMFS) to map species distributions and essential fish habitat for federally managed species as required by the 1996

amendments to the Magnuson Fishery Conservation and Management Act (Magnuson-Stevens Act) and to map critical habitat for marine and anadromous species listed under the Endangered Species Act.

Constructing a National Workshop

In 1998, USGS and NOAA, with the support of the Ecological Society of America (ESA), began to explore the development of a national partnership and a workshop that would bring together the major contributors and users of the products of an aquatic habit assessment program. Both agencies recognize the benefits of an aquatic habitat assessment partnership that would unify and make comparable characterizations of freshwater, estuarine and marine biological resources from mountain springs and streams to the continental shelf.

On September 3-4, 1998, a national workshop to assess the needs of information users was held in Washington, DC (Appendix A). The workshop was funded by USGS and NOAA and organized in coordination with other federal, state and private and professional organizations, including U.S. Fish and Wildlife Service (USFWS), International Association for Fish and Wildlife Agencies (IAFWA), ESA, The Nature Conservancy (TNC) and American Fisheries Society (AFS). Ninety-one people representing 40 organizations and agencies attended the workshop (Appendix B) with another 20 people joining the group for an evening social. Demonstrations and exhibits from 17 aquatic assessment or mapping programs were on display throughout the workshop (Appendix C).

The primary objective of the workshop was to obtain preliminary guidance from those organizations that can benefit from the Partnership and to identify ways in which each can participate. The 1.5-day workshop began with a series of presentations that provided background on the current status and need for an aquatic habitat assessment program. The afternoon and following morning consisted of facilitated working group sessions that focused on

three resource-related questions: What aquatic resource issues does your organization face? What aquatic resource questions do you need to answer? and, How do you currently get the information to answer these questions? The final session focused on identifying a set of fundamental steps that should be taken to initiate the program. This report is a summary of the findings of that workshop, including background information, case studies, discussion results and recommendations.

II. Presentations

Introduction

Susan Haseltine, Deputy Chief Biologist, USGS, BRD, and Dail Brown, Chief, Watershed Division, NOAA, NMFS, opened the workshop with a welcome to the participants and a challenge to use this opportunity to identify the priority aquatic resource issues and design a proposal for how these issues could be addressed.

There is a genuine necessity for a broad-based program that provides timely and reliable information on aquatic resources. Many federal agencies have legislative requirements related to aquatic resources. NMFS, for example, has a legislative mandate (Magnuson-Stevens Act) to set priorities for conservation (both protection and restoration) of marine environments. State, non-governmental and private organizations also collect and use aquatic resource information. Identifying the key issues and determining the questions that need to be answered are important steps in building a program. The broad range of agencies and organizations represented at this workshop provides an opportunity to share information about what participants are doing, and where and how they are doing it. This information forms the base from which to build. It is hoped that the outcome of this workshop will lead to a strong partnership that will address the conservation of the Nation's aquatic resources.

Paul Brouha - Keynote

Paul Brouha, former Executive Director of the

American Fisheries Society, set the tone for the workshop by comparing the information needed to unlock the secrets of watershed function with the Farmingham heart study (Brink 1998). In the Farmington study, people's lives were changed based on long-term monitoring and communicating of the results that related diet and exercise to heart disease. The same could be true for watershed conservation. Long-term monitoring of aquatic resources and communicating the results will provide watershed stewards with the tools they need to protect, enhance and conserve our aquatic resources.

Such tools are beginning to be developed from a variety of sources. A significant amount of data and information have been collected by states and others and much of it can be used to develop a consistent monitoring and assessment program. To fully utilize the data and information collected, consistent methods are needed so that scientifically sound information can be shared. Results can then be made available and applied in a wide range of management scenarios.

The following concepts should be considered in building a successful watershed assessment program.

* Keep the basic concepts simple, straightforward and accessible.
* Avoid scientific jargon by using language that both policy makers and the public can understand.
* Provide incentives for sharing information, adopting comparable standards and working together.
* Communicate with users.

This workshop is the beginning of a journey to create a change in community values. The message to be instilled is that watersheds are all connected, regardless of the artificial boundaries we place upon them. To foster a change in how we manage, conserve and restore aquatic resources, we must begin to pool our information, data and expertise. This workshop offers a promising beginning.

Michael Jennings, USGS "The Gap Analysis Program: An Introduction to Natural Resource Assessment"

Michael Jennings, Director of the National Gap Analysis Program, provided information on the origin, purpose, structure and goals of the National Gap Analysis Program. Simply stated, gap analysis methodology originated through applying landscape-level identification of habitats and species distributions. Gap analysis is a science-based program for identifying the degree to which native species and natural communities are represented in our present-day mix of conservation areas. Those species and communities not adequately represented in the existing network of conservation areas constitute conservation "gaps". The purpose of the National Gap Analysis Program is to provide broad geographic information on the status of species and their terrestrial habitats in order to provide managers, planners, scientists and policy makers with the information they need to make better-informed decisions. Gap analysis is an information tool to aid in protecting and effectively managing biodiversity in order to protect and enhance populations and habitats for rare species, as well as maintaining common species.

The unique feature of the National Gap Analysis Program's aquatic gap analysis project is that it meets the need for coarse-scale, landscape-level information and thus provides for the management of natural resources across political boundaries. The resources associated with a site - for example, a species occurrence, or an unusual habitat or natural feature - can be evaluated in the context of the larger landscape. Various management questions can be asked such as Where else does this resource occur? Is it threatened in other locations? What is the management status of the resource? The historic lack of such information has lead to poor land and water use decisions. When applied to aquatic resources, gap analysis methodology can provide the basis for informed management decisions.

The National Gap Analysis Program structure includes partnerships among state agencies, USGS, academic institutions and private interests, and utilizes a standard business model and technical approach which provides the following:

* Information on how well ordinary species are represented;
* Species habitat needs that are systematically documented;
* Institutional capabilities to develop or use the information needed to manage biodiversity as a resource;
* A focus on state, Regional and landscape scales; and
* Standard definitions, repeatable methods, common information system and a national network of expertise.

The gap analysis approach is particularly relevant to aquatic resources because it can provide the spatial framework, a central core of terrestrial data sets and the business model to "break" the traditional barrier between the management of terrestrial and aquatic resources. Challenges do remain; the considerable effort that was necessary to develop a uniform classification system for terrestrial vegetation must be repeated for aquatic habitats. What must be addressed are issues of scale, mapping a rapidly changing environment and broadening management concepts for aquatic resources from a species-by-species approach to a community-based approach. This workshop and the development of aquatic gap pilot and demonstration projects in more and diverse habitats could provide the means for a truly national effort that connects aquatic resource management across political boundaries.

Case Studies

The case studies were chosen to represent both marine and freshwater systems. Although more needs to be done in developing the science to assess aquatic habitats on a landscape scale, good projects are already underway. Three case studies were selected to provide workshop participants with background information about ongoing efforts in aquatic habitat classification and mapping.

Box A. The National Gap Analysis Program

The National Gap Analysis Program was initiated by the USFWS and transferred to USGS to provide a landscape-level framework for effectively conserving and managing species and biological communities. Gap analysis utilizes Geographic Information Systems to depict the species and community distributions in the context of other key geographic and environmental data sets. In addition to species distributions, the primary GIS layers include (1) vegetation cover, delineated using a nationally consistent classification derived from satellite imagery (2) land ownership, and (3) land management status. The National Gap Analysis Program started in 1987 and is generally conducted on a statewide basis. Currently, terrestrial-based gap analysis efforts are completed or underway for most of the United States.

Status of GAP State Projects in 1999

- ■ Completed
- ▨ Near Completion
- □ Not Started
- ⬚ Organizing
- ▨ Underway

Working on:
Crayfish
Fish
Mussels
Snails

The National Gap Analysis Program has developed a nationally consistent approach to developing tools for natural resource conservation and management, including program management, building partnerships, data acquisition, data and metadata standards, quality control, validation and information analysis.
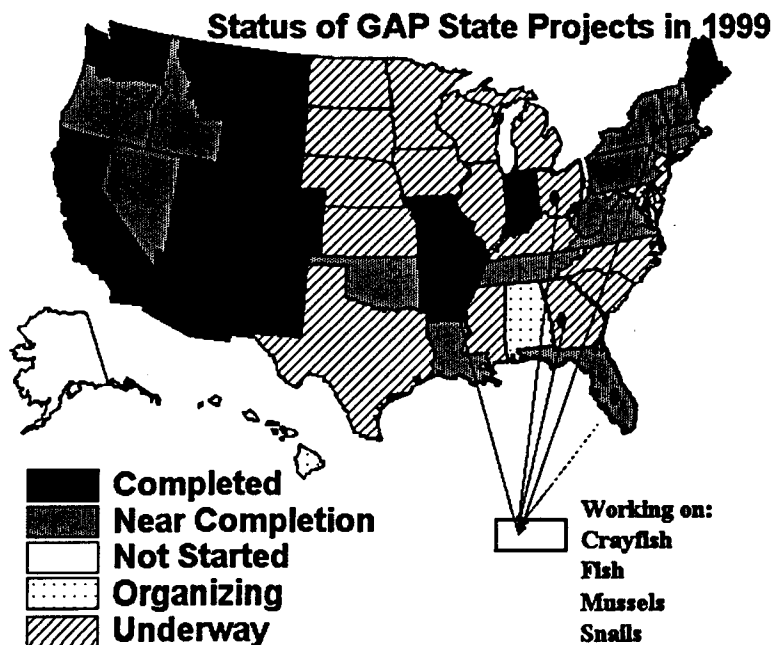
A. Setting Marine Conservation Priorities for Latin America and the Wider Caribbean

Georgina Bustamante, Regional Fisheries Ecologist, TNC's Florida and Caribbean Marine Conservation Science Center, presented an approach TNC used to classify marine waters for identifying areas where conservation efforts would be feasible. This analysis covered coastal areas, extending throughout the Exclusive Economic Zone from the shoreline to the 1000-meter depth contour for Latin America and the wider Caribbean. Coastal areas were delineated, assessed and ranked based on a series of determinations. Three levels of delineation were used for this process. First, areas were classified into provinces (level 0) based on climate and flora/fauna composition. A total of nine provinces were proposed. These provinces were further classified into biogeographical divisions, incorporating coastal processes. Twenty-six experts were convened to delineate, evaluate and rank the provinces into these biogeographical divisions (level 1). The ranking approach addressed habitat loss, source of threats, water quality, abundance of species and feasibility. Political indicators were used to determine feasibility; these included enforcement authority, existing or regulations, basic science capacity and the degree of public participation. Finally, these same experts applied this ranking approach to the biogeographical divisions to determine ecologically sensitive units or coastal areas (level 2). A series of indicators were used to assign a biological value to the coastal areas: physical factors, richness, endemism (uniqueness), presence of breeding sites and abundance of resources. Once this was completed, status of the areas and potential threats were identified including alteratioh, loss of species and loss of or impact on breeding or nursery grounds.

B. Missouri Aquatic Gap Pilot Project

Scott Sowa, Aquatic Resource Coordinator, Missouri Resource Assessment Partnership (MoRAP), presented a status report of the aquatic gap pilot project in Missouri. This project was initiated by MoRAP (an interagency group comprised of state and federal agency representatives) and the National Gap Analysis Program. MoRAP was created to serve as a forum to identify information needs, provide information for natural resource management, minimize difficulty in communication among agencies and ensure information sharing. The goal of MoRAP is to develop and disseminate high-quality natural resource information at the lowest possible cost so partner agencies can efficiently accomplish natural resource management. Projects are developed by interagency committees and working groups with MoRAP staff. These working groups form the structure and oversee MoRAP projects. The proposals are reviewed by a standing technical committee to ensure that they conform to sound data standards and then are presented before the steering committee for possible funding. Partner agencies are under no obligation to provide funding for any given proposal. The independence of all partners is affirmed, and the advantages of pooling funds for any given project are openly and carefully considered.

Smallmouth Bass Distribution by 11 & 14-digit Hydrologic Unit

11-digit Hydrologic Unit   14-digit Hydrologic Unit

■ Hydrologic units where Smallmouth bass have been collected
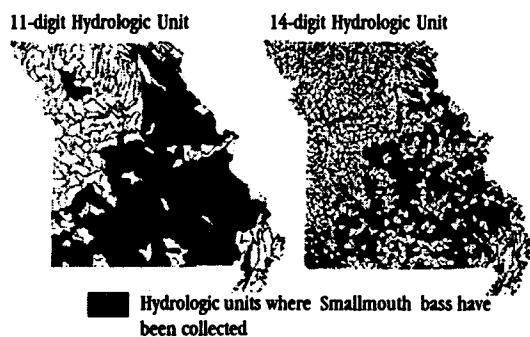
Figure 1. Distribution of smallmouth bass in Missouri by 11 and 14-digit hydrological units. Comparison of these maps shows how different scales can depict spatial data. Wide ranging species such as smallmouth bass appear to have a spotty distribution when displayed at a 14-digit scale. Whereas, using 11-digit hydrological units to display a rare species give the appearance of a broad distribution. The dilemma is determining the spatial scale which is ecologically meaningful for the species under consideration.

The Missouri aquatic gap pilot project is one of several MoRAP projects. Utilizing the gap analysis methodology, the specific goals of the Missouri pilot are to develop an objective method to identify and prioritize gaps in aquatic resources; to develop a means to integrate methods; and to document information needs, methods and procedures used in the project.

The pilot project's focus is on riverine systems (physical) and fish, mussels, crayfish and snails (biological). The approach involves four steps: (1) classify streams into distinct valley segments, (2) assess the conservation status, (3) predict the biological potential, and (4) revise conservation priorities. Valley segment classes are designed to delineate the riverine system into ecologically meaningful units. This is accomplished using protocol developed by TNC (see below). Biological potential is determined based on three factors: (1) distribution of species at the watershed level (figure 1), (2) habitat affinities as defined through extensive literature reviews, and (3) habitat templates.

At the time of the presentation, known distributions and habitat affinity databases had been completed and the valley segment data layer is under development. Some major obstacles identified include the lack of community data, habitat affinity data, standardized coding for data, valley segment data, digital data, trained personnel and funding. For this program to be successful, decisions must be driven by data and partners must agree on a common framework for delineation and assessment.

C. An Aquatic Community Classification System
Jonathan Higgins, TNC Aquatic Ecologist, presented TNC's approach to aquatic (freshwater) community classification and conservation. This approach involves assessing the distribution and abundance of rare and endangered species and all natural communities and setting conservation goals for each conservation target in every ecoregion. A standard classification approach was developed to assess the variability of aquatic ecosystems and their community-level biodiversity and to identify conservation priorities for protection.

Box B: The New York Aquatic Gap Pilot Project

Watersheds span large land areas, encompass a connected range of stream sizes and integrate natural and altered properties of a drainage area. Methods are needed to identify the locations of high biodiversity in watersheds, compare aquatic biodiversity distributions among regions and provide watershed-scale information useful for targeting conservation measures. An aquatic version of gap analysis has been developed in the Allegheny River drainage in western New York State to resolve two main questions: (1) Is there adequate biological information to link faunal composition to stream reaches (tributary confluence to confluence) on a large scale? and (2) Can useful physiochemical data be assembled for stream reach habitat classification? This project defines the methodology and evaluates the feasibility of predicting biodiversity distribution at the watershed scale.
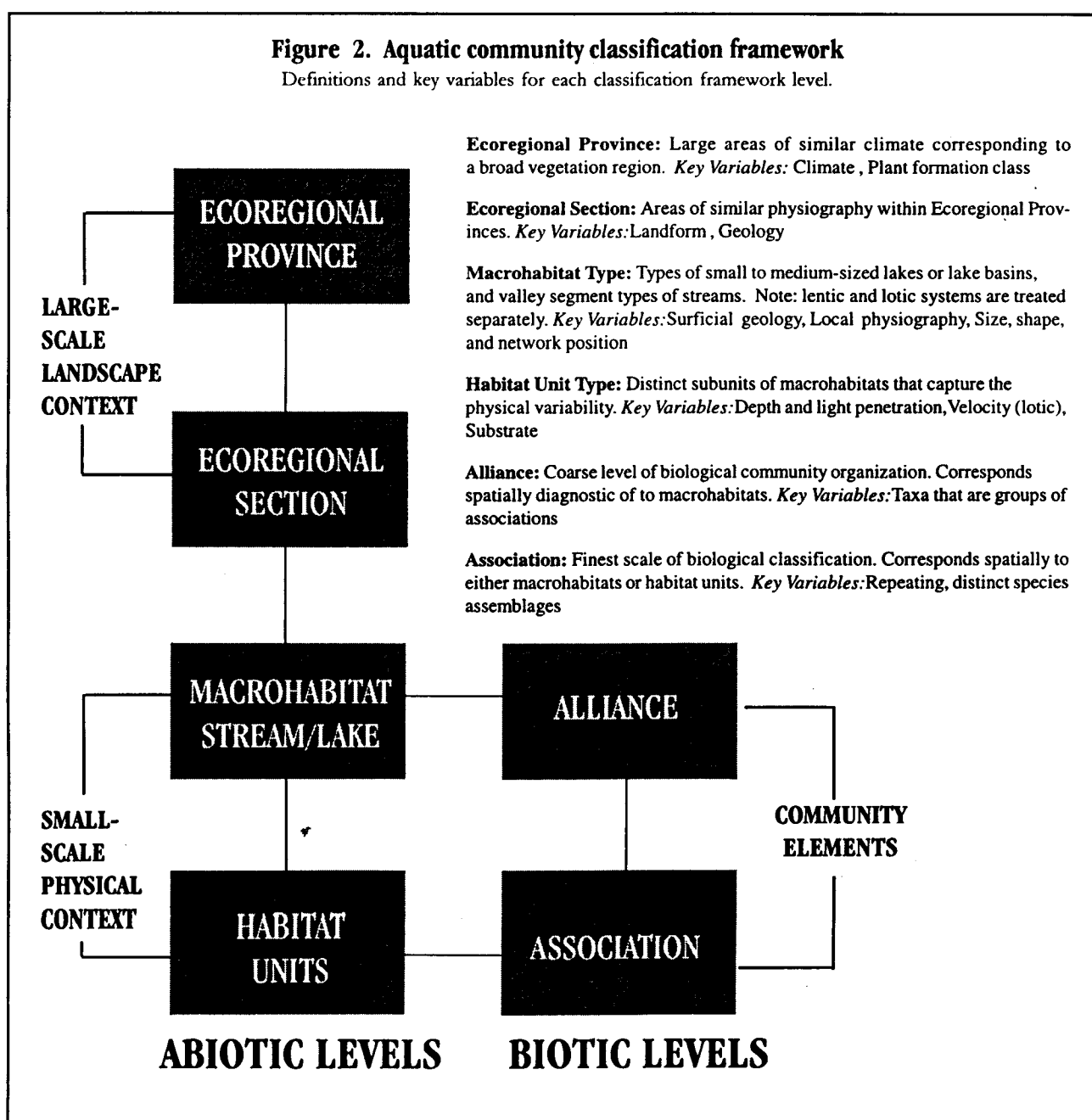
The standardized stream reach accounting system is based on EPA's Reach File 3 System. Each stream reach is classified into one of 18 habitat types for fish faunal predictions and one of eight habitat types for invertebrate faunal predictions. Habitat types were defined using the following sets of physiochemical attributes: (1) stream size (headwaters, large streams/small rivers, large rivers), (2) physical habitat (dominated by natural geomorphological processes, moderately altered and dominated by human structures and controls), (3) water quality (suitable for life support, biologically stressful), (4) gradient (steep, low slope), and (5) riparian forest cover (closed canopy over channel, open channel). Stream size was determined from drainage area using GIS. Physical habitat, reach gradient and riparian forest cover were classified from topographic and land use maps. Physiochemical data from the EPA's STORET database provided a means to classify water quality. The system to determine habitat types was used to predict that the highest fish diversity will be found in medium size streams with natural fluvial channels and good water quality, whereas the most reduced fish faunas would be found in large rivers with highly modified channels and poor water quality. For invertebrates, the areas predicted to have the greatest diversity (in terms of ecological function groups) will be in small and medium size streams with primarily a closed canopy, steep gradient and good water quality.

The classification framework addresses the hierarchy of ecological pattern and process that influence the distribution of aquatic communities. Products from this classification system include maps of aquatic ecological units at different spatial scales and the distributions of biological communities. These maps are generated from existing data on hydrography, climate, landform, geology, hydrologic characteristics and elevation, as well as biological samples. Products support the testing of relationships between the ecological units and the biological communities.

The application of TNC's classification framework for conservation occurs in four general steps: (1) identify, classify and map ecological units called macrohabitats using the regional environmental factors that determine the natural composition and distribution of aquatic communities, (2) analyze biological data to identify communities and correlate their distributions to the macrohabitat types, (3) identify the highest quality and most viable examples of macrohabitats and community types across each ecoregion, and (4) identify a suite of sites that capture these occurrences. These sites become the priorities for conservation action.

Figure 2. Aquatic community classification framework

Definitions and key variables for each classification framework level.

Ecoregional Province: Large areas of similar climate corresponding to a broad vegetation region. *Key Variables:* Climate , Plant formation class

Ecoregional Section: Areas of similar physiography within Ecoregional Provinces. *Key Variables:* Landform , Geology

Macrohabitat Type: Types of small to medium-sized lakes or lake basins, and valley segment types of streams. Note: lentic and lotic systems are treated separately. *Key Variables:* Surficial geology, Local physiography, Size, shape, and network position

Habitat Unit Type: Distinct subunits of macrohabitats that capture the physical variability. *Key Variables:* Depth and light penetration, Velocity (lotic), Substrate

Alliance: Coarse level of biological community organization. Corresponds spatially diagnostic of to macrohabitats. *Key Variables:* Taxa that are groups of associations

Association: Finest scale of biological classification. Corresponds spatially to either macrohabitats or habitat units. *Key Variables:* Repeating, distinct species assemblages

ECOREGIONAL PROVINCE

ECOREGIONAL SECTION

LARGE-SCALE LANDSCAPE CONTEXT

MACROHABITAT STREAM/LAKE

ALLIANCE

HABITAT UNITS

ASSOCIATION

SMALL-SCALE PHYSICAL CONTEXT

COMMUNITY ELEMENTS

**ABIOTIC LEVELS**   **BIOTIC LEVELS**

The classification provides a standard yet flexible framework that can be used to characterize the physical and biological components of aquatic ecosystems and evaluate their biodiversity and environmental quality (figure 2). Classification attributes can be used to describe aquatic ecosystems at multiple scales for a variety of management or conservation objectives.

Panel Presentations

A panel composed of potential users that represented federal, state and nongovernmental entities was formed to give participants a sense of the challenges and needs their organizations face. Each panel member gave a brief presentation that expressed his or her agency's or organization's perspective of aquatic habitat management needs.

A. David McKinney, Chief, Environmental Services, Tennessee Wildlife Resources Agency, provided a state's perspective. Tennessee has rich and diverse freshwater resources: 5 major watersheds, 319 fish species, 76 crayfish, 128 mussels, 96 snails, plus other macro-invertebrates. Tennessee faces management challenges that cover a broad

> The Tennessee Aquatic Data Systems (TADS) is a GIS system that contains 4500 stream reaches, 19,000 miles, 1:500k scale, 16,000 fish records, 1400 sample sites, Lat-long/ Township-Range, codes from Integrated Taxonomic Information System.
>
> **Tennessee Aquatic Database System**
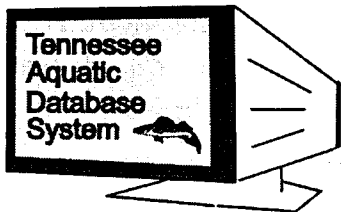
spectrum including impounded water, tailwaters, acid mine drainages, point and non-point source pollution, different reporting requirements among federal agencies, dynamic land-use changes and finding and using data from many sources, including state, university, federal and private. They also face information and data challenges that include the following:

* Taxonomic identification of fish, mussels and benthic invertebrates;

* Consistent use of indicators of biological integrity;
* Continued development of rapid bioassessment methods;
* Identification of watershed reference streams;
* Description of reference fish assemblages;
* Development of big river sampling methodologies;
* Selection of sampling locations;
* Description of riparian characteristics;
* Utilization of in-stream methods;
* Solutions to database incompatibilities; and
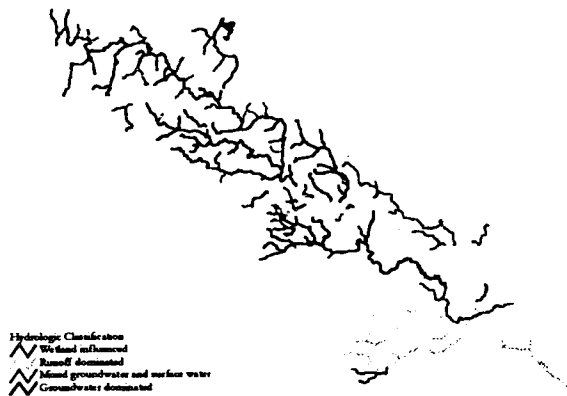* Incorporation of conventional wisdom.

Tennessee is using the Tennessee Aquatic Data Systems in dealing with their aquatic resource needs. Additional help is needed to develop the following activities:

* Unified funding opportunities;
* A partnership coordinating council to develop standards and provide guidance;
* A cooperative clearinghouse where information can be located; and
* Translators so information can be shared.

Tennessee needs aquatic resource information and tools to pursue economic opportunities (development, recreation, etc.), to protect unique fish species and manage fisheries, to identify species that are indicators of resource health and to fulfill legislative mandates. In general, states will respond to their own needs and will address the short-term versus long-term problems.

B. Brian Richter, Director, TNC Freshwater Initiative, provided a nongovernmental perspective through a description of TNC's work in conservation planning for aquatic biodiversity. The United States' aquatic resources are significant in a global context and information for making management decisions about these important resources is essential. Examples from TNC's publication, *Rivers of Life*, demonstrate the global significance of U.S. freshwater species: 10% of the world's freshwater fish species, 61% of the world's freshwater crayfish, 30% of the world's freshwater mussels, 15% of the world's freshwater snails, 40% of the world's stoneflies and 30% of the world's mayflies are found in the United States.

Box C. The Nature Conservancy's Freshwater Initiative

Hydrologic Classification
N Wetland influenced
N Runoff dominated
N Mixed groundwater and surface water
N Groundwater dominated

The Nature Conservancy (TNC) is a nonprofit organization dedicated to the protection of plants and animals and the habitats they need to survive. TNC has recognized that freshwater species and communities are even more threatened than their terrestrial counterparts. In response to the growing challenge of freshwater biodiversity conservation, TNC has launched an organizationwide Freshwater Initiative. This five-year Initiative has three major goals: (1) Use scientific data and methods to identify the most critical waters deserving conservation attention; (2) Help local communities, resource agencies and other conservation partners create sustainable ways of living on the land that maintain natural water flow patterns and water quality in more than 30 watersheds; and (3) Leverage freshwater conservation skills and information by fostering collaboration, learning and information exchange among freshwater conservationists. The site-based focus of strategy (2) will bring new expertise and approaches to 38 watershed projects in the United States, Latin America and the Caribbean, focusing on hydrologic alteration and nonpoint source pollution. In carrying out this Initiative, TNC recognized that it lacked a scientifically sound, yet practical, method for classifying aquatic habitat types, mapping them, and evaluating their relative conservation priority. Thus, a critical first step was the development of a nationally standardized aquatic community classification system that enables the targeting of limited conservation resources. TNC's new system is being developed in cooperation with universities, conservation organizations, and government. First applied in the Great Lakes watershed, it is now being integrated into TNC's ecoregional planning efforts. Such a classification system is a key component in TNC's efforts and to the development of consistent aquatic habitat assessment programs. More information about the freshwater Initiative is available at www.freshwaters.org

The Nature Conservancy has launched a five-year Freshwater Initiative that will include:

* Supporting conservation planning efforts at the ecoregional level to identify the most important watersheds for conservation;
* Building national data sets so that species distribution maps can be produced using data from many sources;
* Implementing TNC's aquatic classification system;
* Developing tools for assessing threats to aquatic systems at valley segment or 8-digit watershed scales;
* Increasing the viability of populations of aquatic species at demonstration sites;
* Increasing the exchange of freshwater knowledge and skills through the Freshwater Learning Center; and
* Building partnerships with other freshwater conservation groups and agencies.

C. Rowan Gould, Deputy Assistant of Fisheries, USFWS, provided the perspective of a federal agency that manages both freshwater and certain marine systems. The mission of USFWS is to work with others to conserve, protect and enhance fish, wildlife and plants for the continued benefit of the people of the United States. They address this mission through 7 regions, 53 ecosystems usually based on watersheds, more than 550 refuges, ecological services offices, fisheries resource offices, wildlife resource offices and the National Wetlands Inventory. Their challenges and needs encompass two goals: (1) sustainability of fish and wildlife populations and (2) habitat conservation. Aquatic resource information tools could be used to:

* Address issues for specific trust responsibilities, migratory birds, interjurisdictional fish species (e.g., in the Great Lakes) and anadromous species;
* Recover endangered species;
* Identify the effects of aquatic, nonendemic, nuisance species that can change the original habitat;
* Plan aquatic habitat projects as they relate to fish passage;
* Protect wetlands;
* Improve land acquisition priority systems;
* Plan restoration projects;
* Create refugia for endangered species at national fish hatcheries; and
* Monitor trust species and refuge activities and endangered species.

has had notable successes, such as the recovery of the gray whale, other species such as the right whale and monk seal continue to decline (figure 3).

* NMFS recently listed its first threatened marine plant - Johnson's seagrass. Meanwhile, less well-studied marine organisms are being lost before ever being identified, much less protected.

NOAA and its partners need to explore new approaches to managing these marine living resources:

* Identifying and prioritizing key marine and estuarine areas of importance to biodiversity, fisheries, protected species and key ecosystem functions;
* Conserving and restoring priority areas;
* Incorporating ecosystem approaches;
* Using the precautionary approach; and
* Partnering among all stakeholders.

These new approaches will be proactive and set priorities for geographic areas rather than managing species by species. This is analogous to preventative health care, and elements of these new approaches are already being incorporated into NOAA's federal resource management strategies.

* 32 states, territories and commonwealths manage more than 99% of the nation's shorelines in federally approved integrated coastal zone management programs.
* National Marine Sanctuaries and partnerships with National and state parks are protecting key areas of coastline.
* Habitat conservation agreements with states, tribes and private land owners help address endangered species management goals.
* "Essential fish habitat" provisions of the 1996 Sustainable Fisheries Act provide a new tool for sustainable management of fisheries.
* New tools are being developed, such as experimental "no-take" fishery reserves that help manage fisheries while protecting biological diversity.

There are many benefits of developing partners and sharing data. As the aquatic habitat assessment program is developed, it will address and meet NOAA's goals.

Concluding Comments

Mary Barber, Director, ESA's Sustainable Biosphere Initiative, offered a personal perspective and synthesis of the morning presentations and workshop structure. The enthusiasm of those involved in developing the new program is considerable. While this enthusiasm should capitalized on, acknowledgment must be made that undertaking the new program will not be simple. Two pieces of advice are offered: (1) to focus on the needs and potential benefits of an aquatic habitat assessment program, and (2) even though the process itself may be complicated, to keep the products simple. The issues involved are being dealt with at the watershed level and include ecosystem management approaches, therefore this new program should move beyond the conservation focus of the National Gap Analysis Program and include management and regulatory needs. However, full advantage should be taken of the ten years of technical experience and data that already exist within the National Gap Analysis Program. Perhaps the program name should reflect more than an aquatic perspective. The proposed program is very special and provides an opportunity to experiment with an array of potential tools, many of which may turn out to provide more than is presently imagined.

The morning presentations were designed to provide a sample of the visions and perspectives of various institutions, and the case studies were chosen to illustrate the status of the science and current efforts. The afternoon and following morning sessions are intended to (1) define ways to develop and continue partnerships, (2) articulate information needs, and (3) decide what each of the participants can offer in developing The Partnership.

III. Work Groups

Workshop attendees were divided into three facilitated work groups based on their personal or

Development of an aquatic resource information tool should consider the following:
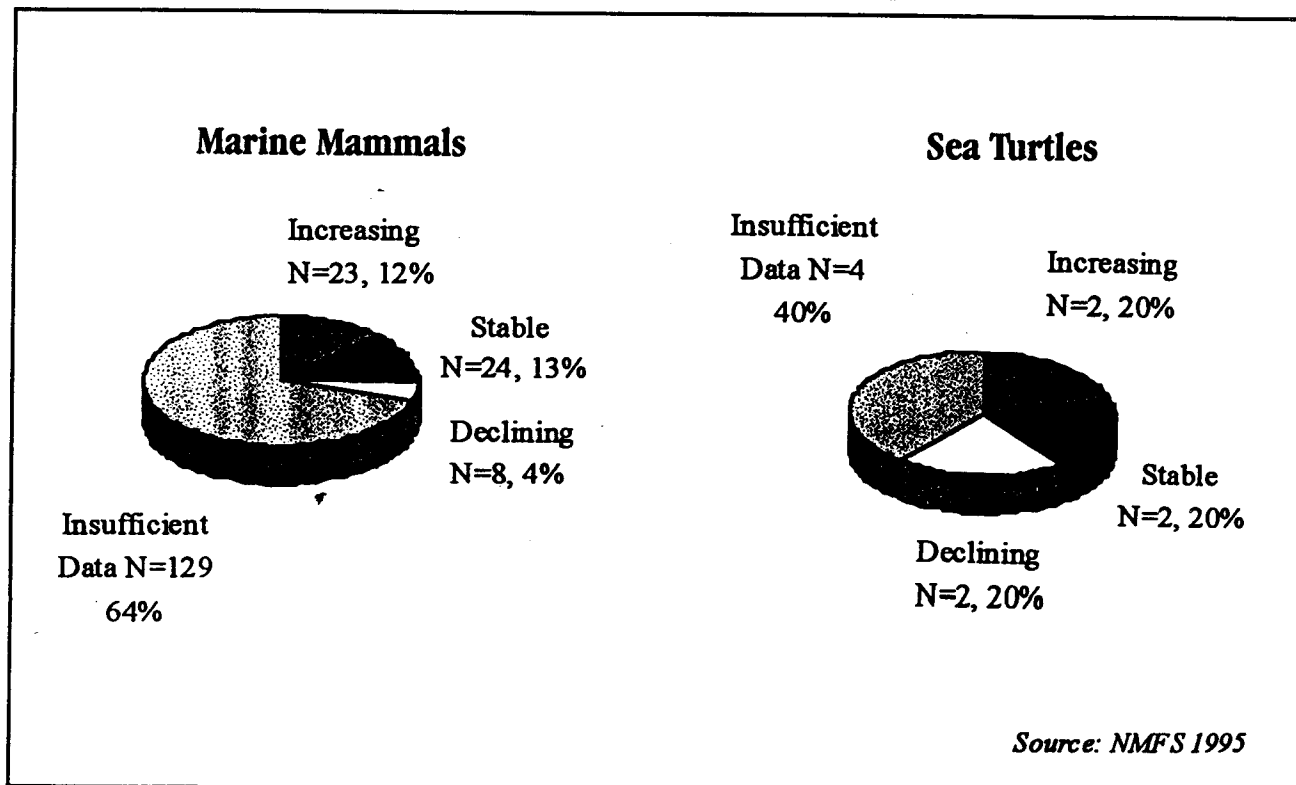
* Characterization versus classification of aquatic resources;
* Capturing changes over time;
* Layer ecosystem parts (fish/ ducks/ water quality) at a spatial resolution that enables each component at a site to fit together;
* Uses of in-stream flow; and
* Uses of water (flow, public drinking, hydropower, agriculture, fish and wildlife and designated Clean Water Act uses, etc.).

USFWS can bring talented biologists who have experience with surveys, in-stream flow, contaminant assessments and restoring wetlands to this partnership. Jamie Clark, Director of the USFWS, recognizes the status of the nations aquatic resources and that proactive habitat restoration and recovery should be a national priority. Aquatic resources are a living process and this must be a living tool. USFWS stands ready to bring expertise to the table in the development of this important initiative.

D. Tom Hourigan, Biodiversity Coordinator, NOAA, NMFS, provided the perspective of a federal agency dealing with managing marine and estuarine systems. NOAA's environmental stewardship mission is to build sustainable fisheries, sustain healthy coasts and recover marine and anadromous protected species. The challenges facing marine environments in the United States and worldwide have never been greater.

* Population density along the U.S. coast is four times the national average and growing, placing increasing burdens on natural systems.
* Coral reefs are the most biologically diverse marine ecosystems, yet 10% of the world's coral reefs have already been degraded beyond recovery, and another 30% are likely to decline in the next 20 years.
* Sufficient data are available for only 300 of 844 U.S. federally managed fishery species, yet fully one third of these - including many of the most valuable fishery stocks - are overfished or approaching being overfished.
* Protected species are also under increasing stress. Although management through the Endangered Species Act and Marine Mammal Protection Act

Figure 3. Status of U.S. Marine Protected Species.

Marine Mammals

Increasing
N=23, 12%

Stable
N=24, 13%

Declining
N=8, 4%

Insufficient
Data N=129
64%

Sea Turtles

Insufficient
Data N=4
40%

Increasing
N=2, 20%

Stable
N=2, 20%

Declining
N=2, 20%

Source: NMFS 1995

agency interests, each representing a different aquatic habitat type: streams, marine/estuarine and lakes/wetlands. This approach to organizing the work groups was based on differences among the technical foundations currently existing within the three habitat groups (e.g., a great deal more habitat classification work has occurred in stream environments compared to estuarine environments). Participants were asked to participate in the work group sessions as knowledgeable professionals, not necessarily as representatives of their agency or organization. The work groups met on the afternoon of the first day to identify issues, questions and information sources. Each group was asked to address the following questions:

1. What aquatic resource issues does your organization face?
2. What aquatic resource questions do you need to answer?
3. How do you currently get the information to answer these questions?

The second morning began by reconvening the work groups to review a list of issues synthesized by the planning committee from the results of the previous day's discussions. For the bulk of the morning, the participants were asked to list their priority issues and to identify the initial sequence of steps that should be taken in developing The Partnership. At the end of the morning the meeting concluded with a facilitated discussion among all participants that led to an overall sequencing of initial next steps for program development. The following subsections summarize the individual session outcomes.

A. Streams

Participants in this group included a mixture of state and federal representatives as well as a few nongovernmental representatives. Despite this eclectic mixture, the issues, needs and concerns expressed were consistent among the group. Among the three work groups streams (and rivers) has the greatest amount of experience to draw upon. Broad-scale assessment of aquatic biologic resources already exist at the federal level (for example, the two ongoing aquatic gap analysis pilot projects in Missouri and New York), as well as biological assessments that have been incorporated into state programs, such as Ohio EPA.

What are the primary aquatic resource issues facing your agency/organization?

Compatibility. The most important issue is inconsistent methodology and data collection techniques, which interlinks with the major need - consistency and compatibility. Determining what the partners want the program to accomplish and enabling it to easily tie to existing terrestrial components is key.

Scale. Scale is an issue at several levels, including isolation of ecological units and watershed versus state boundaries. Scale must be at a level that is applicable to the user's needs. The difficulty of obtaining species distribution data is also an issue that involves a scale component (i.e., distributions based on jurisdictional boundaries).

Others. Issues with a biological focus, including exotics, bioindicators, "focal species," "true" ecological indicators, status of biodiversity and biomonitoring are important.

What are your data/information needs?

Policy-level Communication. The ability to get the message to policy makers and legislators is important. The technical expertise is there, but the challenge is in connecting it to policy.

Trends. The program should be sensitive to trends - it must go beyond presence/absence.

Threats. The major threats to aquatic habitats are known, but more stakeholder involvement and economic information are needed to help predict threats. Indicators must be able to anticipate threats within 10% or less error. These indicators should include land-use type and effect on aquatic resources; data layers necessary to relate changes in land and water use to changes in the biological community; geomorphic, hydrologic, water quality (especially non-point) data; and data layers/information that include both community and key species information. Biological, physical and chemical characterization is necessary to provide an understanding of how water and land management strategies affect stream health.

Breadth of Information Need and Access. Eventually, an active gap assessment effort will be needed in all the states. In this regard, the issue of access is important and data should be available on a web site so everyone can have access. Funding is a major issue as well as the need to identify the program's applications. Standardization and comparability of habitat characterization/ classification, metadata and taxonomy are also serious issues.

Anticipating Rapid Change. Rapid change in aquatic systems through such events as floods, drought and changes in land and water use means that The Partnership cannot be a static process.

How are Your Current Information Needs Met?

Current information resources include a mix of data, information and data resources, which, combined, do not meet the information and management needs of any of the agencies and organizations represented, including regulatory and nonregulatory federal agencies, states (both management - and inventory - focused agencies) and private organizations. Issues of incomplete coverage, scale, incompatibility, access to data, differences in scale, etc., make the current conditions for conducting successful management and conservation of aquatic resources problematic.

What should be the next steps in the development of an aquatic resource assessment?

* *Identification of the issues/problems the program would address and accomplish.* If the new program is to build or expand on the National Gap Analysis Program, then it must be broadened from an "inventory" to a strong management tool. Some participants suggested building on the "standards" of National Gap Analysis Program, but in rebuttal, it was pointed out that one cannot build on a "standard" that has not been defined. For example, the two current aquatic pilot projects under the National Gap Analysis Program use different approaches.
* *Develop a general set of objectives.* These objectives must address fundamental biodiversity conservation as well as development and use of research/management tools.
* *Multiple context and coordination.* Concern was expressed that federal agencies would generalize states needs, i.e., that federal agencies would assume that needs and uses would be equivalent for all states. The program will need multiple context and coordination, not simply to ensure that a diverse partnership is established, but to recognize that each agency has a different charge (e.g., water quality, quantity, fish and wildlife, habitat). This program must include the full spectrum.

There were several other issues that were touched upon and will need to be discussed further. These include the relationship with the National Gap Analysis Program and the use of the term aquatic gap. It was suggested that using the term "aquatic gap" would prove confusing to policy makers and appropriations staff. However, it is possible that use of the term aquatic gap would confer a message that the success of "terrestrial gap" can be applied to other important areas, i.e., aquatic systems.

B. Lakes/wetlands

Participants in the lakes/wetlands group came from diverse backgrounds that included state fisheries management agencies, state gap projects, federal fish and wildlife management agencies, federal regulatory agencies and non-government organizations. The major concerns among the group were standards in definitions, coding and data collection, linking to information systems and

dealing with the volume of data that already exists. For this group, the goal of the program is support for conservation of aquatic ecosystems and an informed community.

What are the primary aquatic resource issues facing your agency/organization?

Assessment and analysis of information. Includes integrating data across systems, developing criteria for use in land and water management plans, determining the relationship of local management units into a regional conservation context and looking at past assessments to predict future outcomes.

Identification and prioritization. Includes identifying best examples for protection or conservation, identifying species or areas of importance, prioritizing limited resources and identifying areas where development or management may have the least or most impact.

Relationship among the effects to aquatic resources. Includes addressing cumulative impacts, determining the change nonindigenous species have on the environment, determining the effect of human impacts, measuring the recovery from natural disasters, determining the magnitude of problems and measuring water quality and quantity effects.

Establishment of baseline conditions. This provides the starting point to measure success and is the basis for a national status and trends assessment; however, determining the baseline may be difficult because of the wet/dry cycle of aquatic systems.

Solutions to data, methodologies and standards issues. Includes developing standards for classifying resources and coding data, agreeing on standard definitions, developing methodologies to measure parameters and analyze information; resolving issues of scale (both temporal and spatial) and accessing data.

Administration and structure of a program. Includes concerns about the need for specific program goals, who would manage a program, funding options, developing partnerships and ensuring that the tools developed provide management information and links to management practices.

What are your data/information needs?

Compatibility and use of existing data. Although some information already exists, the format and quality may pose access or analysis problems. Information needs include classification, categorization or analysis of existing data.

Standards and methodologies. Development of standards and methodologies is a critical step in moving forward and sharing information. There are several programs address some of the issues related to standards and methods, for example MARIS uses the lowest common denominator across data sets to ease sharing of information.

Data needs. Specific data needs include habitat classification, management prescriptions, restoration areas, lake names, nonindigenous species, nuisance species, surficial geology, soil types, aquifers boundaries, water quality, dam descriptions, pollution sources, historical land use, in-stream use, dams, levees, hard structures, vegetation changes, water intakes/outakes and FEMA areas.

How are your current information needs met?

Rather than focusing on how information needs are met, the group discussed basic questions about information as they considered these questions important in evaluating any information set. Some of the questions include: (1) How comprehensive is the information? (2) What time frame does it cover? (3) What value does it have? (4) Where is it located? (5) What is its quality? (6) Does it show trends over time? (7) Can it be accessed?

What should be the next steps in the development of aquatic resource assessment?

The goals and objectives of the program were discussed prior to identifying next steps. These should include the following:

* Identifying hot spots (important areas) of biodiversity;

* Taking advantage of opportunities to integrate and address multiple needs;
* Answering important resource management questions;
* Prioritizing the areas for conservation;
* Indicating broad application;
* Demonstrating public benefit;
* Providing accessibility and user-friendliness;
* Offering decision support systems for a variety of different questions;
* Delivering information to appropriate end users;
* Developing marketing tools; and
* Providing decision support for issues of economic development, water quantity.

Next steps should include:
* Taking advantage of existing partnerships;
* Creating a structure that will be broad enough to include watershed, ecosystem and state levels;
* Ensuring regional communication and coordination;
* Bringing participants together to identify specific data layers;
* Convening states for a meeting;
* Get majority of states to define next steps; and
* Looking at pilots.

The overall goal of the program should be to develop a tool for land and water planning and management, and conservation of healthy ecosystems.

C. Marine/estuaries

Participants included representatives of federal and state agencies, fishery organizations, scientific societies and environmental nongovernmental organizations. Among the three work groups, the marine and estuarine group was the most diverse, both in terms of ecosystems covered and management problems faced. It was recognized that although a tremendous amount of work was going on at different governmental and nongovernmental levels, there had been few previous efforts to organize and standardize work and approaches across states and ecosystems. For this reason, a gap analysis approach, while new to many of the participants, appeared both welcome and challenging.

What are the primary aquatic resource issues facing your agency/organization?

The diversity of participants was reflected in the diversity of marine and estuarine management issues that they faced. Three main themes were identified : (1) habitat quality, (2) land, water and resource use, and (3) marine protected areas. Within each theme, several issues were described.

Habitat quality. These issues are key to maintaining the health and productivity of marine and estuarine ecosystems. Water quality is a major determinant of habitat quality in nearshore systems, and concerns include pollution and eutrophication. Loss of physical habitat, *e.g.,* coastal wetlands, through direct conversion to other uses or through other alterations is a major issue for managers. There is a need for information about the historical distribution of natural habitats. Fishery gear impacts, *e.g.,* impacts of trawling, are seen as a major issue affecting habitat quality in both inshore and offshore waters. The introduction of exotic species and disease are also increasingly affecting habitat and resource quality and productivity. Managers need to be able to place these human-induced changes in the context of natural disasters, such as hurricanes, and the natural interannual variability that characterizes the marine environment.

Land, water and resource use. These issues are closely tied to issues of habitat and water quality. Population growth, development, and changes in land use are occurring faster in coastal areas than in most other regions of the country. Ensuring the sustainable use of fisheries resources is also a major concern, particularly as more and more stocks appear to be overfished. Aquaculture, the fastest growing sector of U.S. food production, has potential impacts in the coastal zone. Many of these issues are subsumed under the concept of integrated coastal area and resource management, yet several participants believe that current approaches do not adequately address the problems of living marine and estuarine resources.

Marine protected areas. Marine protected areas are a specific issue because of the perceived value in conserving intact natural communities, habitats and species. It was noted, however, that most protected areas are currently designated more for their scenic beauty than for the purpose of conserving living marine resources. Managers want to be able to analyze the effectiveness of marine protected areas management and pay attention to social aspects of marine protected areas. The concept of "no-take" fishery reserves is also an important issue merging protected area and fishery management approaches.

Several concerns were raised while identifying issues. These concerns involve political aspects, funding and public awareness. For instance, there is general agreement in the need for a precautionary approach to living resource management. The precautionary approach states that in the face of uncertainty, managers and decision makers must err on the side of conservation of living marine resources and protection of the environment.However, applying such an approach requires political will and entails short-term costs to important economic sectors. This makes the need for clear, reliable and accepted information all the more important. In response to these concerns and in light of the issues identified, it was agreed that any marine and estuarine habitat assessment program must address the following major themes or issues:

Acceptance - The tool must be generally acceptable as trustworthy and accurate;

Communication - It must foster communication among scientists, managers, resources users, conservationists and the general public;

Focus - It must serve to focus research, monitoring, management and resource use efforts;

Scale - It must address appropriate spatial/temporal scales; and

Integration across land-water interface - It must ensure that on-land activities, including all the way up a watershed, are addressed because they impact estuarine and marine systems.

What are your data/information needs?

There is currently a lack of information on marine biodiversity, data dissemination and compilation, transcription of historical data retrieval and synthesis, standard habitat classification systems, data compatibility and "infomatics", that is, the science of information management. In a large number of areas management is constrained by a lack of information. The following types of information are necessary to implement marine and estuarine habitat analyses:

* Classification of habitats;
* Distribution and delineation of habitats;
* Distribution and abundance of species: [1]
   * representative species
   * managed species
   * protected species
   * structuring species (e.g., reef-building corals or seagrasses)
   * assemblages
* Species/habitat relationships and development of predictive models;
* Conservation units - identifying current conservation efforts, frequently there are not even comprehensive maps of current state and federal protected areas;
* Determination of the spatial domain of the data collection and analysis - includes determination of mapping units to meet the user's needs;
* Determination of comparability (when necessary) to terrestrial or freshwater scales;
* Spatial definition of threats or stressors - both their source and impact;
* Substrate quality;
* Development of standardized protocols for data synthesis and monitoring; and
* Identification and mobilization of taxonomic expertise.

Research and development needs include the following:
* Incorporation of ecosystem considerations;
* Analysis of effectiveness of marine protected areas management;
* Indicators of ecosystem health;
* Impacts of climate change; and
* Understanding natural variability.

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[1] It was noted that information on species abundance was not incorporated into the terrestrial gap analysis approach, but this information is particularly important for and accessible through fishery data and could therefore play an important role in marine and estuarine models.

How are your current information needs met?

In general, specific information sources were not identified during the work group sessions. However, it is clear that several GIS-based mapping efforts are underway, particularly on the shoreward side of coasts. In addition, a great deal of water quality and other monitoring data exists that provide information for specific management questions, such as contaminants in shellfish, fisheries statistics and harmful algal blooms.

What should be the next steps in the development of an aquatic resource assessment?

The following next steps were recommended to meet the needs of the stakeholders and to implement a marine and estuarine component of an aquatic habitat assessment program:

* *Establish a steering committee.* This committee should include both sponsoring agencies and holders of the data, as well as users of the data (i.e., regulatory and management agencies). Tasks of the steering committee would include:

    * Developing vision, goals and objective;
    * Establishing policy advice;
    * Promoting outreach to partners, including fact-finding and marketing the gap analysis approach;
    * Mobilizing federal funding and seeking matching funds from partners;
    * Orchestrating of gap analysis implementation; and
    * Identifying pilot projects.

* *Inventory existing activities, data, experts and users.* There is a lot of ongoing work being done by different organizations, but it is widely scattered and difficult to assess. A core team will probably compile the data, but much of the inventory would be best accomplished on a region-by-region basis, perhaps divided by bioregion or large marine ecosystem. Specifically, the effort for data identification should include:

    * Both data sources and existing data layers (i.e., both raw data and GIS-ready data);
    * Existing mapping exercises;
    * Existing marine and estuarine habitat classification schemes;
    * Lists of experts and potential users; and
    * Information on how data are currently stored and disseminated.

* *Develop partnerships at a regional (or state) level.* This step is envisioned as occurring concurrent with the data inventory, which would help serve as a partnership building effort. A clear vision statement developed by the steering committee will be important for this effort. Particular emphasis should be placed on end users of the tool. Partners will include, inter alia:

    * Coastal states and territories;
    * Tribes;
    * Fishery management councils and interstate fishery commissions;
    * Organizations representing fishers;
    * Nongovernmental organizations;
    * University researchers and labs;
    * River basin and watershed committees; and
    * Federal agencies, including NOAA; Dept. of Interior (US Fish and Wildlife Service; USGS; National Park Service; Mineral Management Service); EPA (which is very important to include); USDA; Department of Transportation; Department of Defense.

* *Develop habitat classification schemes for estuarine and marine environments.* This is a particularly important activity. Approaches in marine and estuarine environments are not as advanced as for those freshwater and terrestrial systems. Such habitat classification activities would include the following key points:

    * Build on the data/activity inventory;
    * Design to meet end user's needs;
    * Probably be developed through a series of workshops;
    * Require a peer review process;
    * Habitat classification systems must include biological communities and should aggregate up levels in a comparable fashion to other habitat classification activities; and
    * Should nest within ecosystems or bioregions.

* *Develop pilot marine and estuarine habitat analysis projects.* There is a sense of urgency regarding the need to field-test some of these approaches. The group did not, however, have enough time or information to develop specific recommendations on where or how these pilots should be developed. There was discussion, for example, of doing a pilot on a watershedwide basis, incorporating freshwater, estuarine and marine aspects. There was also discussion of doing a project on a statewide basis with an interested partner (which might involve more than one watershed or concentrate primarily on the

estuarine/marine aspects). There is a general sense that although the pilots would build upon preceding steps, they should not wait until all are completed in order to begin - i.e., the pilot itself would serve as an important learning and partnership-building effort and a means of refining, directing and ground-truthing the habitat classification activity.

Summary of Work Groups

While there were many consistencies among all three work groups, there were distinct differences as well. Table 1 lists the top priorities for each group and the interest or need of each group that is of greatest contrast to the other groups. Within the marine/estuarine group, the need to launch a "fact-finding" mission was very important and considered a high priority. This is due to the greater variety of habitat types, biological communities and species in estuarine and marine ecosystems and the relatively less-developed state of knowledge about these systems when compared to freshwater systems. It was noted that the marine/estuarine side had a great deal of "catching up" to do. It is also worthwhile to note that the freshwater effort may be mainly driven by state-level activities while the marine/estuarine effort may involve more federal, academic and non-governmental agency participation. All three groups agreed that a principal objective would be to develop a consistent and compatible classification system. This system would require integration among the various habitat types, including a terrestrial component.

IV. Conclusions, Next Steps and Recommendations

The enthusiastic response to the workshop and overall active participation in the plenary and work group discussions affirmed the interest and need for a consistent and compatible system that would identify, characterize and make accessible aquatic resource information. Although the freshwater, estuarine and marine sectors are at different stages of development, the objectives and suggested initial steps for The Partnership were consistent among all groups. Based on what was discussed at the meeting, the following sequence of steps was recommended.

Table 1. Top priority issues and major contrasts among the three aquatic resource work groups.

LAKES/WETLANDS	STREAMS	MARINE/ESTUARY
Priority issue: Assessment/ analysis of information; identify/prioritize areas and resources; relationship among effects, baseline conditions.	**Priority issue:** Inconsistency of methodology for data collection and storage; lack of compatible data; integration of data in usable format.	**Priority issue:** Habitat quality; land, water and resource use; marine protected areas.
Contrast: Specific data needs include restoration areas, lake names, surficial geology, water quality, etc.	**Contrast:** Strong support for the aquatic gap program within National Gap Analysis Program	**Contrast:** Greatest need is fact-finding mission; compilation of information.

1. Disseminate workshop report to all participants and other interested parties.
2. Develop and disseminate an outreach document that can be used as an educational and marketing tool.
3. Form an umbrella steering committee made up of representatives from a broad range of partnering groups and individuals to direct administrative and technical development. Initial responsibilities will include the following:
   * Develop a vision and goal statement;
   * Identify potential "champions" and partners, and a marketing approach for the program;
   * Develop a budget that would identify national and local contributors and begin a search for funding;
   * Develop a plan to address data and classification/standardization issues; and
   * Oversee and form theme steering groups.
4. Form theme steering groups for marine and freshwater (with separate stream and lake/wetlands groups or combined). Responsibilities of these groups will include working with the umbrella steering group to address the issues listed above as well as the following:
   * Identify the particular needs and potential partners for each group and develop methods to address these;

* Identify or develop pilot projects; and
* Organize regional meetings, separately or jointly, that will help identify the above, as well as begin to address the technical issues of data form and classification/standardization.

Table 2 provides a summary of the workshop and the steps identified to initiate the program. Later steps will include developing tools for evaluation and adaptive management of the program, identifying ways to make the data accessible for professionals and the general public, and identifying research needs.

The workshop "Assessing Aquatic Resources: A National Workshop to Determine Information Needs" was an important first step in the development of a partnership that is as timely as it is important. Reaching the goals that were identified at this workshop will take time and effort. To be successful and useful, The Partnership will have to include the full involvement of major users and stakeholders as well as the support and commitment of agencies and groups that would benefit from the enhanced decision-making ability.

Table 2. Next steps for developing a national aquatic habitat assessment partnership.

Step 1. Form Umbrella Steering Group *(with representatives from marine and freshwater information users, providers and supporters from a range of governmental and nongovernmental institutions)*

Purpose:
> *Define Vision and Goals*
> *Budget* for national program and for matching contributors (States, NGOs, etc.)
> *Marketing*
> *Build Bridges* to potentially allied groups such as decision support, regulators
> *Formulate and Oversee Theme Steering Groups*

Step 2. Form Theme Groups - *A steering group will be formed for each of the three discipline areas (streams, lakes/wetlands, marine/estuarine):*

Purpose:
> *Bridge Building* to potentially allied groups such as decision support, regulators
> *Pilot Projects* both current and future
> *Fact-finding* to know who has what data. Identify full range of players in this area and select the appropriate contributors to build partnerships
> *Plan Meetings* regionally, with selected stakeholders and states (lakes/wetlands and stream groups), possibly showcasing Missouri pilot, and ask how this approach would fit their needs and identify what needs would not be addressed

Step 3. Implementation and Technical Development
> *Data Issues:* Identify specific needs such as data layers, data sources, access and management of data bases; consider data delivery methods and identify most appropriate approach
> *Classification/Standardization:* Critical to avoid duplication and to streamline efforts

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Appendix A

Thursday, September 3

8:30 - 9:00am   *Registration*

9:00 - 12:30pm   *Background & Presentations* (with 15-minute coffee break)

Welcome and overview of the workshop goals and objectives -
      Susan Haseltine, U.S. Geological Survey
      Dail Brown, National Oceanic and Atmospheric Administration

"Keynote Address" - Paul Brouha, Former Executive Director, American Fisheries Society

"The Gap Analysis Program: An Introduction to Natural Resource Assessment"
      - Michael Jennings, U.S. Geological Survey

Case Studies
      Marine - Georgina Bustamante, The Nature Conservancy
      Freshwater - Scott Sowa, University of Missouri
      The Nature Conservancy's aquatic classification - Jonathan Higgins

      Panel: "Why bother? The need for an Aquatic Gap Analysis Program"
          A State Perspective - David McKinney, Tennessee Wildlife Resources Agency
          Nongovernmental - Brian Richter, The Nature Conservancy
          Dept. of the Interior - Rowan Gould, U.S. Fish & Wildlife Service
          National Oceanic and Atmospheric Administration - Tom Hourigan, National
          Marine Fisheries Service

      Morning wrap-up and afternoon expectations - Mary Barber, Ecological Society of America

12:30 - 1:30pm   *Lunch* (provided)

1:30 - 5:00pm   *Breakout Sessions* (with 15-minute coffee break)
          - Identification of issues, information needs, current information resources

Evening Social

6:00 - 8:00pm   *Welcome, Hors d'oeuvres, Exhibits and Demonstrations*

Friday, September 4

8:30 - 12:30pm   *Reports, Continued Discussion and Synthesis* (with-15 minute coffee break)
Breakout sessions report and discussion
Breakout sessions - Where do we go from here? The role of participating organizations.
Reports and Wrap-up

Appendix B

Workshop Participant List

Robin Abell, *World Wildlife Fund*

Rebecca Allee, *NOAA, National Marine Fisheries Service*

Doug Austin, *Illinois Dept. of Natural Resources*

Mary Barber, *Ecological Society of America*

Peter Barnes, *U.S. Geological Survey*

Joy Bartholomew, *Estuarine Research Federation*

Gris Batchellor, *National Fish and Wildlife Foundation*

Carol Bauman, *Center for Marine Conservation*

T. Doug Beard, *Wisconsin Department of Natural Resources*

Lee Benaka, *Seagrant/American Fisheries Society*

Lisa Borre, *Monitor International*

Paul Brouha, *U.S. Forest Service*

Darrell Brown, *EPA , Office of Wetlands, Oceans & Watersheds*

Steve Brown, *NOAA, National Marine Fisheries Service*

Dail Brown, *NOAA , National Marine Fisheries Service*

Georgina Bustamante, *The Nature Conservancy, Florida & Caribbean Marine Conservation Science Center*

John Christensen, *NOAA, National Ocean Service*

John Cooper, *U.S. Fish and Wildlife Service*

Gladys Cotter, *U.S. Geological Survey*

Michael Crosby, *NOAA, Science Advisory Board*

Chris Darnell, *Coastal States Organization*

Dave Davis, *EPA, Office of Wetlands, Oceans & Watersheds*

Jon Doggett, *American Farm Bureau*

John Epitanio, *Trout Unlimited*

Paola Farreri, *Pennsylvania State University*

Mark Finkbeiner, *NOAA, Coastal Services Center*

Rowan Gould, *U.S. Fish and Wildlife Service*

Roger Griffis, *NOAA , Office of Policy & Strategic Planning*

Dennis Grossman, *The Nature Conservancy*

Sue Haseltine, *U.S. Geological Survey*

Pam Haverland, *U.S. Geological Survey*

Eugene Hester, *American Sportfishing Association*

Jonathan Higgins, *The Nature Conservancy*

Jennifer Hill, *Federal Energy Regulatory Commission*

Ted Hoehn Kautz, *Florida Game and Freshwater Fish Commission*

John Hoey, *National Fisheries Institute*

Tom Hourigan, *NOAA, National Marine Fisheries Service*

Mike Jennings, *U.S. Geological Survey*

Randy Kautz, *Florida Game and Freshwater Fish Commission*

John Klein, *NOAA*

Liz Kramer, *University of Georgia, Institute of Ecology*

Rhonda Kranz, *Ecological Society of America*

Steve Leathery, *NOAA , National Marine Fisheries Service*

Michelle Leslie, *The Nature Conservancy*

Michael Mac, *U.S. Geological Survey*

Jim Markham, *Maryland Department of Natural Resources*

Amy Mathews-Amos, *Marine Conservation Biology Institute*

Bill Mauck, *U.S. Geological Survey*

Morgan McCosh, *U.S. Fish and Wildlife Service*

Tony McDonald, *Coastal States Organization*

Bonnie McGregor, *U.S. Geological Survey*

Laura McKay, *Virginia Coastal Program, DEQ*

David McKinney, *Tennessee Wildlife Resources Agency*

Abbie Meador, *Chesapeake Bay Program*

Bob Miles, *International Association of Fish & Wildlife Agencies*

Tim Miller, *U.S. Geological Survey*

Mark Monaco, *NOAA, National Ocean Service*

John Mosesso, *U.S. Geological Survey*

Steve Moyer, *Trout Unlimited*

Tom Muir, *U.S. Geological Survey*

Doug Newcomb, *U.S. Fish and Wildlife Service*

Doug Norton, *EPA Office of Wetlands, Oceans & Watersheds*

John Pemberton, *National Cattlemen's Beef Association*

Lilian Pintea, *The World Bank*

Barbara Jean Polo, *American Oceans Campaign*

Don Pryor, *Office of Science & Technology Policy*

Ann Rasberry, *Maryland Department of Natural Resources*

Tom Rhodes, *U.S. Agency for International Development*

Brian Richter, *The Nature Conservancy*

Andy Robertson, *NOAA, National Ocean Service*

Herman Robinson, *U.S. Fish & Wildlife Service*

Susan Russell-Robinson, *U.S. Geological Survey*

Eric Slaughter, *EPA, Oceans and Coastal Protection Division*

Greg Smith, *U.S. Geological Survey*

Jack Sobel, *Center for Marine Conservation*

Scott Sowa, *Missouri Resource Assessment Partnership*

Chuck Spooner, *EPA , Office of Water*

Rich Takacs, *Chesapeake Bay Program*

Melanie Tarver, *International Association of Fish & Wildlife Agencies*

Jim Thomas, *NOAA, National Marine Fisheries Service*

Dwight Trueblood, *NOAA, Estuarine Reserves Division*

John Tschirky, *The Nature Conservancy, LACD*

Sara Vickerman, *Defenders of Wildlife*

Jeff Waldon, *Fish and Wildlife Information Exchange*

Tim Warner, *Conservation International*

Lani Watson, *NOAA , Office of Policy & Strategic Planning*

Pace Wilber, *NOAA, Coastal State Organization*

Bill Wilen, *U.S. Fish and Wildlife Service*

Ken Williams, *U.S. Geological Survey*

Jim Williams, *U.S. Geological Survey*

Amy Wing, *U.S. Fish and Wildlife Service*

Dorsey Worthy, *NOAA, Coastal Services Center*

Appendix C

Demonstrations/Exhibits/Displays
On view during workshop lunches and breaks
and Thursday evening social

Center for Marine Conservation - Marine & Coastal Protected Areas

Chesapeake Bay Broadscale Ecological Strategy for Targeting (BEST) Program

Florida Game and Fish Commission Aquatic Gap

Missouri Aquatic Gap Pilot

New York Aquatic Gap Pilot

NOAA/National Ocean Service

Oregon Biodiversity Project

Teaming with Wildlife

The American Fisheries Society

The Nature Conservancy

U.S. Fish and Wildlife Service - Coastal Work

U.S. Fish and Wildlife Service - Great Lakes

U.S. Fish and Wildlife Service - National Wetlands Inventory

U.S. Fish and Wildlife Service - Neuse-Tar Watershed

U.S. Fish and Wildlife Service - Striped Bass Movements

U.S. Geological Survey - Coastal and Marine Geology Program: Mappers and Students of
the Aquatic Substrate

U.S. Geological Survey - Gap Analysis Program

Aquatic Gap

A Partnership for the Conservation of Living Resources in Marine and Freshwater Systems

The Issues

The need for information on the freshwater and marine living resources of the Nation has never been greater. Forty-five percent of the current endangered species are freshwater and coastal aquatic organisms – fish, marine mammals, sea turtles, freshwater mussels, crayfish, and amphibians – and whole ecosystems – e.g., wetlands and coral reefs – are facing increasing threats. The decrease of aquatic biodiversity – the variety of marine and freshwater living organisms and the ecological complexes of which they are a part – is a major concern of state and federal natural resource management agencies. This loss is an indicator of habitat destruction and degradation of water resources that are vital for economic growth and stability. Currently, there is a lack of tools to objectively measure changes in aquatic biological resources or the success of management policies and restoration efforts. Decision makers and resource managers need tools to measure aquatic resource health and which can assist them in assessing management strategies.

Background

Gap analysis is a science-based program for identifying the degree to which native animal species and natural communities are represented in our present-day mix of conservation areas. Those species and communities not adequately represented in the existing network of conservation areas constitute conservation "gaps." The purpose of the Gap Analysis Program (GAP) is to provide broad geographic information on the status of species and their terrestrial habitats in order to provide managers, planners, scientists, and policy makers with the information they need to make better-informed decisions. Highly successful in the terrestrial environment, this approach can be augmented by including an Aquatic Gap.

Aquatic Gap

The goal of an **Aquatic Gap** Partnership is to characterize and map freshwater, estuarine, and marine species, communities, and their habitats on a landscape scale. With this information, decision makers and resource managers at local, state, regional, and national levels can evaluate aquatic resources and more effectively make land and water resource decisions. To be successful and useful, **Aquatic Gap** will be developed in full partnership with major users and stakeholders.

Aquatic Gap will:

- build a partnership with the major users, managers, and stakeholders.
- develop a system to make information easily and widely available and compatible across political and geographic boundaries.
- facilitate the development of integrated classification schemes for all aquatic resources - freshwater, estuarine, and marine.
- identify, characterize, and map freshwater, estuarine and marine resources using remote sensing and ground-truthing.
- develop decision-support models and application of GIS mapping technology to tie land and water use patterns to aquatic resources.
- identify gaps in the knowledge about aquatic resources.
- determine the impacts of current land and coastal area management practices on long-term stability of aquatic resources.
- identify and prioritize the aquatic resource issues that need to be addressed.

Next Steps

The development of an Aquatic Gap Partnership as a nation-wide effort will make use of the freshwater Aquatic Gap pilot activities currently underway in New York and Missouri. The National Marine Fisheries Service (NMFS) is concurrently developing methodologies to map, conserve, and

restore habitats for anadromous, estuarine, and marine endangered species and federally managed fishery resources. During 1998, USGS-BRD will join with NMFS to build on these efforts by:

- ▸ Hosting, in September 1998, a national meeting with major users and stakeholders to identify the issues.
- ▸ Organizing regional meetings to identify the resource issues, develop priorities and to build support.
- ▸ Facilitating the development of integrated classification systems.
- ▸ Establish an Aquatic Gap steering team which would direct the administrative and technical development.

USGS-BRD has requested a budget increase in FY99 to implement the freshwater component of an Aquatic Gap program in other areas of the country, in particular the southeastern United States. NMFS has requested a budget increase in FY2000 to implement the estuarine and marine component of an Aquatic Gap program.

Questions Addressed

The information provided through an Aquatic Gap Partnership could address issues at several management scales—watershed, state, regional, and national. Some of the questions that can be answered are:

- What is the condition of the nation's estuarine, marine and freshwater ecosystems – how much is protected, how much is pristine, how much is degraded?
- What is the relative health of a watershed, estuary or coral reef compared to other similar ecosystems?
- What aquatic species and communities would be expected in a particular watershed or coastal area – are they there?
- Where are restoration efforts taking place – were they successful?
- Are protected watersheds or coral reefs really healthy?
- Where would conservation efforts be most successful?
- What kinds of freshwater, estuarine, and marine resources are there and how much?
- Where would a specific land- or resource- use practice have minimal impact?
- Which species and ecosystems are showing signs of decline?
- What are the effects/impacts of different management strategies?
- Where is the best location for protection/restoration activities?

What will be developed?

Several geographic information system (GIS) digital data layers may be components of Aquatic Gap and available for use as independent coverages. Examples include:

- ▸ Stream network
- ▸ Marine bottom characterization
- ▸ Ecoregions
- ▸ Watersheds, wetlands, estuaries, and coral reefs

- ▸ Distribution of freshwater and marine resources
- ▸ Public land and coastal area stewardship
- ▸ Land cover and submerged vegetation or habitat types

Other components that will result from Aquatic Gap include:

- ▸ Habitat models for aquatic organisms
- ▸ Common coding schemes

- ▸ Common aquatic classification system
- ▸ Conservation/Preservation areas

Partners

US Geological Survey
US Fish and Wildlife Service
The International Association of Fish & Wildlife Agencies

National Marine Fisheries Service
The American Fisheries Society

The Nature Conservancy
The Ecological Society of America

For more information contact:

Pam Haverland
US Geological Survey
Biological Resources Division
12201 Sunrise Valley Drive
Reston, VA 20192
703-648-4050 Fax: 703-648-4042

Tom Hourigan
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910
301-713-2319 Fax: 301-713-0376

Appendix E

Acronyms and Definitions

Acronyms:

ESA	Ecological Society of America
EPA	Environmental Protection Agency
GIS	Geographical Information System
FEMA	Federal Emergency Management Agency
MARIS	Multi-State Aquatic Resources Information System
MoRAP	Missouri Resource Assessment Partnership
NGOs	Nongovernmental organizations
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
TNC	The Nature Conservancy
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

Definitions:

Gap analysis A landscape level framework for effectively conserving and managing species and biological communities. Utilizes GIS to depict the species and community distributions in the context of other key geographic and environmental data sets.

Habitat Those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity.

Small scale Provides less detail of a larger area. An example would be a scale of 1:1,000,000 or a map of the world, which would have less information about the United States than a map of the United States alone.

Large scale Provides more detail of a smaller area. An example would be a scale of 1:25,000 or a map of the United States, which would have more detail about individual states than would a map of all of North America.